

## ALTERNATIVES FOR NEONICOTINOIDS IN A RANGE OF AGRICULTURAL CROPS

(collected from national extension services in Italy, UK and NL)

Neonic	Crop	Pests	Type of use	Chemical alternatives	More sustainable solutions
Clothianidin, Thiamethoxam	Maize	Click beetles (wireworm)	Seed coating	Methiocarb, Tefluthrin, Zeta-cypermethrin, Cypermethrin	Very regional problem; pest does not cause much economic damage (only in 1% exceedance of economic threshold)
Imidacloprid	Maize	Noctuid moths, European corn borer (ostrinea), Root worm (Driabotica)	Seed coating	Tefluthrin, Dianem, Alfa- Cypermethrin, Deltamethrin, Lambda-cyalthrin	Root worm is a crop rotation problem. European corn borer prevented by accurate tillage of maize harvest residues and/or use of Trichogramma Applications of Bacillus thuringiensis; for Diabrotica Entomopatogenic nematodes are available
Imidacloprid Thiamethoxam Acetamiprid	Peas/beans	Aphids, thrips, Noctuid moths, European corn borer	Spraying	Deltamethrin Pirimicarb Lambda-cyhalothrin, Spinosad, Spyrotetramat,	Alternatives for moths (use economic thresholds, <i>B.thuringiensis</i> subsp. <i>kurstaki</i> and <i>aizawai</i> ) Aphids can be controlled by azadirachtin application (neem extract)
Thiacloprid Acetamiprid	Oil seed rape	Pollen beetle	Seed coating	Indoxacarb Pymetrozine Cypermethrin	Beetle resistant to pyrethroid insecticides, Monitoring for thresholds necessary, use of entomopathogenic fungi, natural enemies
Clothianidin, Thiamethoxam	Oil seed rape	Cabbage stem flea beetle, aphids, etc.	Seed coating	Fluvalinate, Deltamethrin, Cypermethrin	Natural predators, sparying only after monitoring with yellow traps
Imidacloprid, Thiamethoxam Clothianidin, Acetamiprid, Thiacloprid	Apple	Aphids, leaf-rolling moths	Spraying	Azadirachtin Abamectin, Pirimicarb, Spinosad Spyrotetramat Flonicamid	Natural predators Aphids can be easily controlled by azadirachtin application; Leafrollers can be easily controlled by BT or granulovirus (vs Adoxophies orana)
Imidacloprid, Thiamethoxam, Clothianidin, Acetamiprid, Thiacloprid	Peach	Aphids, leaf-rolling moths, leafhoppers	Spraying	Pirimicarb, Spyrotetramat, Flonicamid, Buprofezin	Aphids can be easily controlled by azadirachtin application; Leafrollers can be easily controlled by BT or granulovirus (vs Adoxophies orana); leafhoppers can be controlled by natural pyrethrum
Thiamethoxam	Grapevine	Leafhoppers and <i>S. titanus</i>	Spraying	Indoxacarb, Chlorpyrifos-ethyl	leafhoppers can be controlled by natural pyrethrum; Crucial the monitoring before spraying

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Imidacloprid	Cabbage	Thrips. Moth	Seed coating/ spraying	Spinosad, Lamba-cyhalothrin, Pyrethroid+piperonylbutoxide Deltamethrin Esfenvalerate	Alternatives for moths (use economic thresholds, <i>B.thuringiensis</i> subsp. <i>kurstaki</i> ) and for thrips (minute pirate bug: <i>Orius spp.</i> ). Thrips are a minor problem on cabbages; no treatments needed
Thiamethoxam	Cabbage	Aphids	Seed coating/ spraying	Pirimicarb, Spyrotetramat, Piperonylbutoxide/pyrethrinen Pymetrozine	Aphids can be easily controlled by azadiracthin application
Imidacloprid	Leek (for seed)	Thrips	Seed coating	Spinosad, Abamectine, Deltamethrin, Piperonylbutoxide/pyrethrinen	Alternatives for thrips (minute pirate bug: <i>Orius spp.</i> ), entomopathogenic nematodes Azadiracthin and natural pyrethrum (without piperonylbutoxide) are realistic alternatives
Imidacloprid, Acetamiprid, Thiamethoxam	Eggplant	Aphids, Colorado beetle, Whiteflies, Flies ( <i>Liriomyza</i> )	Spraying	Spyrotetramat, Etofenprox	Aphids can be controlled by azadiracthin Application; Colorado Beetle can be controlled by bacillus thuringiensis sv. Tenebrionis of Azadiracthin as well as whiteflies. Whiteflies there are many beneficial insects to be released and Beauveria bassiana and other entomopatogenic fungi are registered
Imidacloprid, Acetamiprid, Thiamethoxam	Melon	Aphids	Spraying	Fonicamid, Spyrotetramat, Pymetrozine	Alternatives (aphid predators) Aphids can be controlled by azadiracthin application
Imidacloprid, Clothianidin, Acetamiprid, Thiamethoxam	Potato	Aphids, Colorado beetle	Spraying	Novaluron, Metaflumizone	Alternatives for Colorado beetle ( <i>B. thuringiensis</i> subsp. <i>tenebrionis</i> )
Imidacloprid, Thiamethoxam	Tomato	Aphids, Whiteflies	Spraying	Fonicamid, Spirotetramat, Azadiractine, Fluvalinate	Alternatives for whiteflies in greenhouse (Predator mite, entomopathogenic fungus) Aphids can be controlled by azadiracthin application (already included)
Thiamethoxam, Imidacloprid	Trees (nursery)/ flowers	Aphids	Spraying	Azadiractin, Fonicamid, Pyrethroids, Pirimicarb, Pymetrozine, Spirotetramat	Azadiracthin already included
Imidacloprid	Flower bulbs	Aphids, Thrips, Cicades, div. flies	Spraying	Pirimicarb, Esfenvaleraat, Deltamethrin, Pymetrozine Lambda-cyhalothrin Spirotetramat Fonicamid	Azadiractin